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ITS SOURCE AND SANITARY
ASPECTS.

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CHEMIST, WATER DEPARTMENT, WORLD'S COLUMBIAN EXPOSITION.

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Chicago receives its water supply from Lake Michigan through tunnels at four different points, Lake View, Chicago Avenue, Fourteenth and Sixty-eighth Streets, varying from one to four miles in length. Within a few months, extensions now in course of construction at Lake View on the north, and Hyde Park on the south, will be completed, and no water will be received in the city from a source nearer than two miles from the shore.

The first tunnel constructed was at Chicago Avenue, was five feet in diameter, and completed March 25, 1867. A seven-foot tunnel parallel to the first was completed July 12, 1874, each two miles in length, to an intake common to both.

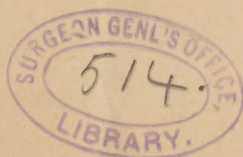
The Hyde Park tunnel, seven feet in diameter and extending one mile, was completed July 22, 1885, and has been the only source of supply at that point since.

The Lake View tunnel, six feet in diameter and extending one mile into the lake, was completed April 5, 1892.

The four-mile tunnel at Fourteenth Street was completed December 8, 1892. It consists of two tunnels, each six feet in diameter, extending two miles to join an eight-foot tunnel extending to the four-mile crib.

The capacities of the tunnels in twenty-four hours are as follows:

Chicago Avenue...	130,000,000 gallons.
Sixty-eighth Street.....	72,000,000 "
Lake View	72,000,000 "
Fourteenth Street	140,000,000 "
Total	414,000,000 "



From the Chicago Avenue works to the Twenty-second Street pumping station, there is a tunnel seven feet in diameter and four miles in length, passing under the Chicago River and the South branch, which is intersected at Harrison street works by a seven-foot tunnel from the Fourteenth Street works.

The water is pumped into the mains by twenty-six engines, as follows :

6	pumps at Chicago Avenue, with a capacity of	96,000,000	gallons.
9	" at Sixty-eighth Street, " "	77,000,000	"
2	" at Twenty-second St., West Side, "	60,000,000	"
3	" at Fourteenth Street, with a capacity	54,000,000	"
2	" at Central Station, Harrison Street,	36 000,000	"
4	" at Lake View, with a capacity of	30,500,000	"
Total		353,500,000	"

The water from the Lake View works supplies Lake View, Twenty-fifth and Twenty-sixth wards, and part of Jefferson, the Twenty-seventh ward.

Hyde Park works supply Hyde Park and Town of Lake, wards Twenty-nine to Thirty-four. The old city is supplied from Chicago Avenue and Fourteenth Street, with a main leading from Fourteenth Street tunneled under the river to the Town of Lake, wards Twenty-nine, Thirty, Thirty-one. All, however, are so constructed that the water from Lake View may supply Hyde Park, and vice versa.

Before the construction of the Fourteenth Street and Lake View tunnels, Lake View was supplied by water taken from the lake through several iron pipes laid upon the bottom of the lake, and extending from 1,400 to 2,000 feet into the lake about fifty feet apart.

With the great growth of the city, the Chicago Avenue tunnels were not sufficient to furnish water for the Harrison and Twenty-second Street pumping works, so that some six years ago a short additional tunnel was extended 3,000 feet at Chicago Avenue for fire emergencies, which at various times during those years, particularly in 1892, was in use in common with the two-mile tunnel, but now permanently closed.

From Belmont Avenue north, sewers empty into the lake every half mile. The largest of these is at St. Lawrence Avenue, one-half mile to the north of the Lake View pumping station.

On the South side, at Twenty-second Street, Thirty-fifth, Forty-third, Fifty first, Fifty-sixth, and Seventy-first Streets, sewers empty into the lake, while all other sewers empty into the river.

During times of freshet there is a current in the river to the lake, which, of course, carries sewage with it, consequently water taken from the shore intake at Chicago Avenue must be more or less polluted with sewage. The same will apply to the old intake through the iron pipes at Lake View.

From the junction of Fullerton Avenue and the North branch of the river there is a tunnel extending to the lake through which water is pumped into the North branch, and which has a capacity of 147,750,000 gallons per twenty-four hours, and is used to flush that branch of the river when required.

At the junction of the South branch of the Chicago River and the Illinois & Michigan Canal there is a pumping station which pumps water from the South branch into the Illinois & Michigan Canal, which conducts it south to the Illinois River, and ultimately to the Mississippi River. These works are now pumping 407,936,000 gallons per twenty four hours, and the capacity will soon be increased. These pumping works, except in times of heavy rainfall, will, because of the sluggish character of the Chicago River, produce a decided current in it from the lake toward the pumps, so that it is only in times of freshet that the Chicago River flows into the lake.

The extensions of the various tunnels within the past two years have undoubtedly secured for the city a water less liable to sewage pollution than was formerly obtained. The available analyses of the water are perhaps inadequate to accurately measure the improvement, but fortunately we can apply that most satisfactory of all water tests, the typhoid fever death rate test.

The improvements in the water intakes have not all been made at a single date, but if we compare the two years ending September 30, 1892, and September 30, 1893, we find that during the earlier year the shore intakes at both Lake View and Chicago Avenue were in common use, while the four-mile tunnel was not yet opened, while for the greater part of the later year the shore inlets were entirely closed and the four-mile tunnel at Fourteenth Street and the one-mile tunnel at Lake View were in use.

The improvement in the death rate from typhoid fever with these changes in the water supply is well shown by the following

table of the rates in the various wards of the city and in public institutions for the two years:

TABLE SHOWING DEATHS FROM ALL CAUSES AND FROM TYPHOID FEVER
BY WARDS FOR TWO YEARS ENDING SEPT. 30, 1892,
AND SEPT. 30, 1893.

WARD.	YEAR ENDING SEPT. 30, 1892.			YEAR ENDING SEPT. 30, 1893.		
	Deaths from all causes.	Deaths from typhoid fever.	Per cent of deaths from typhoid fever.	Deaths from all causes.	Deaths from typhoid fever.	Per cent of deaths from typhoid fever.
1	329	9	2.73	320	4	1.25
2	439	20	4.56	451	9	2.00
3	498	34	6.83	483	9	1.86
4	424	20	4.72	437	10	2.29
5	967	79	8.17	843	20	2.37
6	1,133	73	6.44	1,136	36	3.17
7	712	43	6.04	680	19	2.79
8	682	32	4.69	682	13	1.91
9	912	56	6.14	850	26	3.06
10	1,019	60	5.89	1,180	34	2.88
11	587	37	6.30	494	16	3.24
12	863	59	6.84	966	21	2.17
13	704	43	6.11	686	23	3.36
14	868	62	7.14	880	23	2.61
15	960	73	7.60	995	25	2.51
16	1,306	97	7.43	1,187	24	2.02
17	594	43	7.24	488	8	1.83
18	413	20	4.83	375	8	2.13
19	969	40	4.13	931	11	1.18
20	457	42	9.19	392	13	3.32
21	546	38	6.96	511	13	2.54
22	614	40	6.51	523	13	2.48
23	831	68	8.18	657	16	2.43
24	369	28	7.59	332	6	1.81
25	418	24	5.74	423	11	2.60
26	710	38	5.35	654	19	2.90
27	188	12	6.38	226	7	3.10
28	257	8	3.52	230	4	1.74
29	629	24	3.81	704	16	2.27
30	1,168	52	4.46	1,441	34	2.36
31	439	23	5.24	597	11	1.84
32	464	25	5.39	507	12	2.37
33	621	33	5.31	832	22	2.64
34	632	35	5.55	670	23	3.43
Pub. Inst's.	2,404	400	16.64	2,331	153	6.56
Cor. cases..	1,550	1,933
Total for entire city.	26,646	1,790	6.72	26,977	712	2.64

The total number of deaths by months since 1890 are shown by the following table:

TABLE SHOWING DEATHS FROM TYPHOID FEVER IN CHICAGO BY MONTHS.

	1890	1891	1892	1893
January.....	53	67	311	41
February.....	136	61	187	30
March.....	103	71	76	41
April.....	45	136	56	58
May.....	32	408	70	56
June.....	107	167	55	60
July.....	86	200	211	55
August.....	115	182	179	76
September.....	95	198	138	86
October.....	72	171	92	
November.....	67	150	67	
December.....	47	186	47	
Total.....	1,008	1,997	1,489	503

It is most unfortunate for this comparison that the old supplies were partially in use during the first two months of the latter year before the four-mile tunnel was opened, and we may believe that if this had not been the case, the comparison would have been still more favorable to the improved supply.

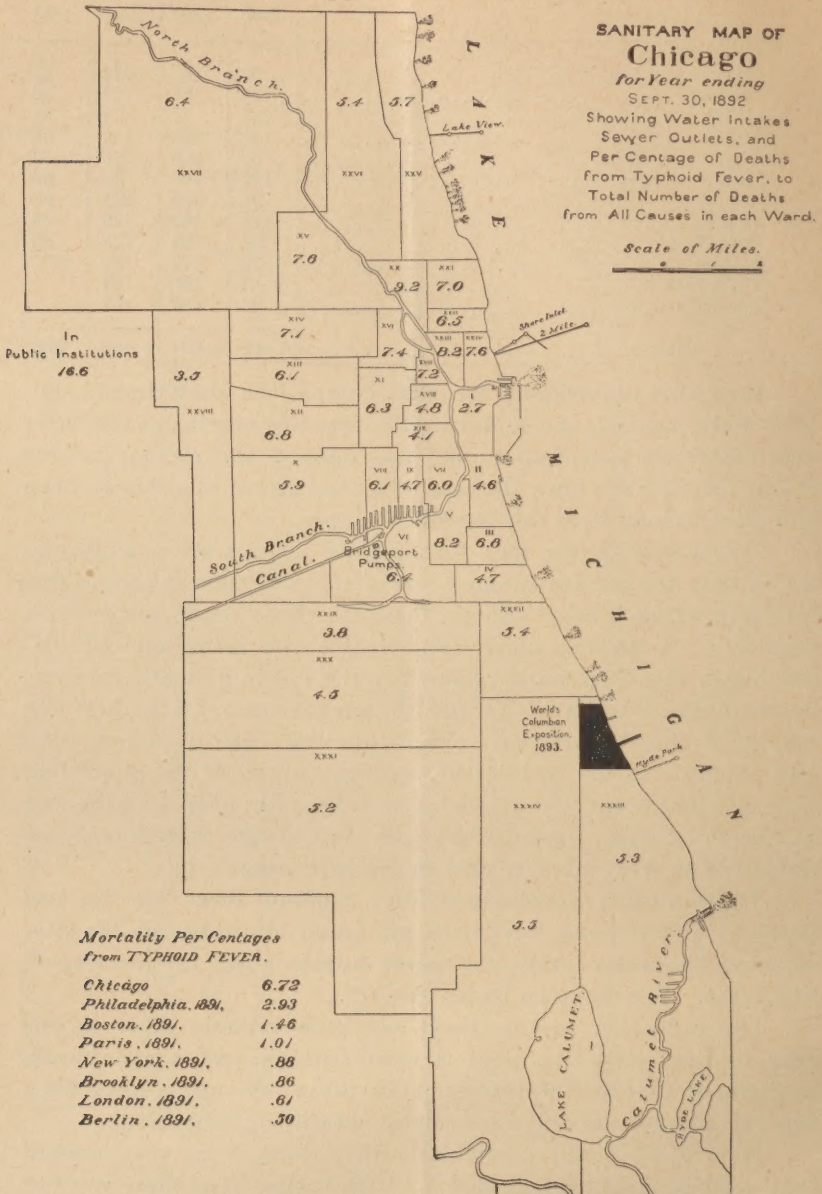
It is a well-known fact that people using a water supply to which they are not accustomed, are often more susceptible to any infection which it may contain than are those using such water regularly. A striking illustration of this was furnished by Philadelphia in the Centennial year when the typhoid death rate was nearly doubled, while in Chicago, the present year, for the first five months of the World's Fair period, the rate has been less than half as high as for the corresponding months of the preceding year, and for the entire years under consideration; in spite of the vast numbers of visitors continually present in Chicago there has been a reduction of over sixty per cent in the percentage rate.

The mortality percentages from typhoid fever for the two years as given above, have been put upon two maps of the city, showing the water intake and sewer outlets in use for the respective years. See maps on pages 376-377.

The reduction in the death rate from typhoid fever in one year of over sixty per cent is most striking, and it can hardly be doubted that the improvements in the water supply have been the chief, if not the only cause in this gratifying reduction.

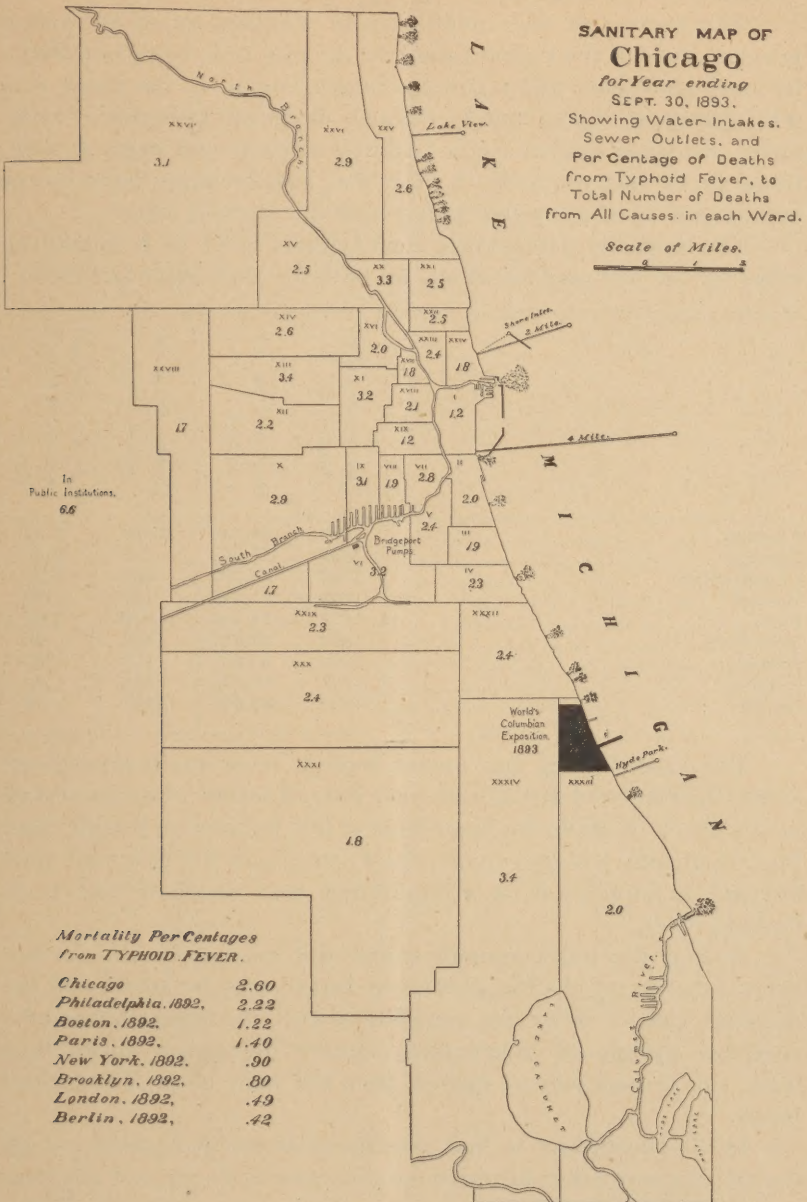
It is to be noted particularly that there is no very marked local distribution of the disease. In the earlier year there was not a ward in the city without an excessive rate. The so-called best wards suffered almost equally with the poorer wards, and the wards on the lake shore were not more favored than those along

the Chicago River. The only general difference to be observed was that those wards supplied with water from the Hyde Park



intake, had somewhat lower rates than the rest of the city, and during the past year, with the improved condition of the other intakes, this difference has disappeared.

As there is no marked local distribution of the typhoid fever, so there were no exceptions to the general improvement with bet-



ter water supply. There was not a single ward in the city which did not show a substantial reduction, although as might be ex-

pected with such a complex problem the percentages in the different wards varied somewhat.

The lessons of the maps may be summed up as showing a general cause of the typhoid fever in the city only slightly affected by local conditions, and a general improvement in the death rate with improved water supply without any local exceptions whatever. Stronger evidence could hardly be produced even if additional proof was required to show the causal relation between the contamination of the water supply and the typhoid fever.

The mortality percentages from typhoid fever in a number of cities for the last year for which we have the data were as follows :

	Year ending September 30.	Deaths from all causes.	Deaths from typhoid fever.	Mortality percentage from typhoid fever.
Chicago.....	1892	26,646	1,790	6.72
Chicago.....	1893	27,977	712	2.64
Philadelphia.....	1892	24,305	539	2.22
Boston.....	1892	11,236	137	1.23
Paris.....	1891	54,443	549	1.01
New York.....	1892	44,317	399	.90
Brooklyn.....	1892	20,857	167	.80
London.....	1892	86,355	424	.49
Berlin.....	1892	32,696	137	.42

The cities having the lowest typhoid fever death rates given above, London and Berlin, use only filtered water. London draws nearly all of its water for some four or five millions of people from the two grossly polluted rivers, the Thames and the Lee, and after filtering it, supplies it to a population that is almost free from typhoid fever.

Among the improvements which will eventually still farther protect the purity of Chicago's water supply may be mentioned the drainage canal. After its completion with the construction of a complete system of intercepting sewers along the entire lake front, the sewage will be turned from the lake to the Mississippi River.

In the meantime it may be a question worth considering by the engineers whether filtration would not be as cheap and effective a means of improving the supply as the farther extension of the tunnels.

CITY HALL.

